

V. *A reply to Dr. Eltringham's paper on the genus Heliconius.* By W. J. KAYE, F.E.S.

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IN reviewing Dr. Eltringham's groupings of the species of *Heliconius* by their genitalia, it is necessary to be very cautious as to the classificatory value of these organs. In some cases close relationship is, on account of practically identical genitalia, liable to be mistaken for co-specificness. No doubt these dissections would be helpful, and where corroborative evidence was forthcoming with series of specimens showing every gradation the results might be regarded as proved. But even in the supposed identical species *melpomene*, *heurippa*, *amaryllis*, *vulcanus*, *xenoclea*, *nanna*, which Dr. Eltringham now considered should include even such hitherto supposed well-differentiated species as *cydno*, *weymeri* and *pachinus*, there is not enough evidence at present in the form of intergraded specimens to make that conclusion wholly acceptable, especially for the last. With the others I am disposed to agree they are probably one species. *Pachinus* seems to offer the greatest difficulty, as it only occurs in Chiriqui and Costa Rica and is there accompanied with *rosina* (without doubt a local form of *melpomene*), but the two show no tendency to unite. Here there would be two subspecies of the same species occurring side by side, which is an untenable position as we at present understand species and subspecies.

Similarly *cydno* and *hermogenes* occur together at Muzo in Colombia, but do not intergrade. *Cydno* always has a white band to the hindwing. It sometimes replaces the yellow band of forewing with a white band, and is then known as *chioneus*. *Hermogenes* always has a yellow band to the hindwing. *Temerinda* is no doubt a form of *hermogenes*, with the spots of the forewing united into a band. Both of these latter forms could have either white or yellow forewing bands or spots, but never, so far as is known, a white hindwing band.

The solving of the *tumatumari* mystery is very satisfactory. *Tumatumari* occurs with *pyrforus* and other

species in the Potaro district of British Guiana. When I described *pyrforus* as a subspecies of *vulcanus*, I did so feeling that it could not possibly be a subspecies of *melpomene*, as *tumatumari* appeared to be another subspecies linking on to *thelxiope*. More recently I have felt convinced that *vulcanus* and its subspecies were really forms of *melpomene*. Now Dr. Eltringham has made the discovery that *tumatumari* is a widely removed species, and thus the old difficulty of two co-existent subspecies vanishes. That *tumatumari* should show strong resemblance to the silvaniform genitalia is remarkable and almost unique among melpomeniform-looking insects. There are probably other species that are as yet undiscovered.

There is one other point in connection with all the forms proposed to be included under *melpomene*. It is somewhat anomalous if one united all the Melpomeniformes and Cydnoformes as one species that *besckeii* should be left out. It occurs only above 2500 ft. in S. Brazil, and is far commoner at 3000 ft. It is possible that it replaces *nanna* of a lower elevation, but intermediates between the two are apparently unknown. Moreover, *nanna* is always rare and *besckeii* very common. I feel disposed to think that Dr. Eltringham is right in separating it as distinct from *melpomene*, but this seems to rather weaken the case for all the other forms being one species, especially as *besckeii* is only slightly different.

The companion species of group II, viz. *erato*, which Dr. Eltringham thinks should include *himera*, *microclea*, *cyrbia*, *favorinus*, *petiveranus*, *hydarus*, and *amphitrite*, is very possibly and even probably true to a large extent, as intergrading series of several have already been found. On the other hand, there is the same difficulty with this group as with *melpomene*. In some cases, such as *cyrbia* and *himera*, we find two constant forms occurring together. Such is the case with these two at Loja in Ecuador. *Erato* is, however, locally so extraordinarily polymorphic, such as in East Bolivia, that it is quite likely intergrades of even *himera* and *cyrbia* will be found in some locality yet to be discovered.

In the Proc. Ent. Soc., 1907, p. xiv, I had already suspected *notabilis* of being an extreme form of *erato*. There is no longer any doubt that many *Heliconius* species can interchange the colours red, white and yellow, and as

*plesseni* can be found intergrading with *xenoclea* there is ground for supposing that the white-banded *cylno* could possibly intergrade with *heurippa*, which is half red and half yellow-banded, and even with *melpomene* itself. The extreme rarity in some cases of white-banded Heliconine forms in place of yellow-banded is a matter for future investigation. *H. telesiphe*, *clissonimus*, and *doris*, the last in both its red and blue form, very rarely occur with white bands on the forewing, yet a species like *antiochus* occurs white-banded over an immense area, and only in a few restricted areas at a considerable elevation is it yellow-banded.

It seems possible that in this case a varying intensity of light might account for the change, in just the same way as many flowers, seemingly white, under the influence of strong light develop a pink pigment. Such, for example, as some kinds of roses and tulips, which will remain white for some days before any colour appears and will even remain white if the weather be dull without sun.

The double spotting of *xenoclea*, *plesseni*, *adonides* and *niepelti*, etc., might be looked upon as another phase of the single spot of *melpomene* breaking up in just the same way as is now known the *thelxiope* spotting is a breaking up of the single spot. In *erato* also the same transitions could easily be traced between the solid spot of *magnifica* and the intermediate semi-broken spot of *calliste*, *callycopis*, *elimaea* and *udalrica*. Forms of *plesseni*, *notabilis*, *xenoclea* and *microclea* have been recorded and figured where the spots were confluent, at once suggesting a *melpomene*-like insect.

In looking at the wonderful changes which both *melpomene* and *erato* are known can undergo, there are some interesting comparisons to be made from fresh-caught specimens and specimens of the same form that are some years old. It is to be seen that in fresh examples of such insects as *feyeri*, *udalrica*, *andremona*, etc., the red markings are all uniformly brilliant. But after about two years the red at the base of the forewing and the streaking of the hindwing becomes brown-red, while the red of the band or blotch of the forewing retains its brilliant colour for some years longer. This no doubt indicates the ancestral character of the forewing blotch and the much more recent and less staple other red marks.

In some cases an approach of one to another form may

be an instance of mimetic approach. Such cases are common with the *Heliconii* such as *H. aoede astydamia*, *H. egeria egeria*, and *H. burneyi catharinae*, which all belong to group II and occur together in the Potaro district of British Guiana. The red marks on the undersides of all forms of *cydno* are sometimes reproduced on the underside of *weymeri*, but these might only be mimetic. *H. choarinus* shows this red marking beneath, but is in no way related to *cydno*, as it belongs to group II.

With the two groups of forms united respectively under *melpomene* and *erato* it is, however, just possible that Dr. Eltringham's contention of their respective co-specificness may be correct. But at present there is a great deal of proof still needed and several obstacles to be overcome.

With several of the other groupings I am afraid I could not agree. *Numata* and *silvana* are, I feel sure, always distinct, and although *numata* varies enormously it is easily separable from the much more stable *silvana*; in British Guiana they would form two subspecies occurring together. With part of the remainder of the forms which Dr. Eltringham groups together into (1), composed of *narcaea*, *ethilla*, *gradatus*, *sulphureus*, it is possible they might be the same, although *narcaea* does not come very close in fascies, but it is significant that going northwards from Rio its habitat, on arriving at Bahia the characteristic white apical patch has become yellow, while further north it is possible the yellow patch might be found broken up into a spotted band so characteristic of a number of the forms proposed to be united.

With Dr. Eltringham's group of species number (2) at the present time it seems impossible to unite *aristiona* with *ithaca* and *aulicus*. *Ithaca* in the female is no doubt a mimic of *aristiona messene*. The two sometimes occur together, but show no tendency to form one species. *Hecale*, *ithaca*, *quitaleus* and *anderida* are quite possibly the same, though the first two needed further proof. The form *fulvescens* figured in the P.Z.S., 1906, Pl. XXXIV, fig. 1, might be an aberration of *hecale (pasithoe)*, or, as has been suggested by Mr. P. I. Lathy, it might be a hybrid between *vetustus* and *hecale*. *Vetustus* occurs along several of the rivers of British Guiana, including the Demerara, while *hecale* is seemingly confined to the latter.

*Atthis* (4) is found to be indistinguishable from *aristiona lenaeus*. This must be only coincidence. No one could

ever suggest it was the same species. I do not think that it could ever even pair with any form of *aristiona*, being separated by the Andes. It occurs at from 1500 to possibly 3000 ft. on the Pacific slope of Ecuador, while *lenaeus* is on the eastern slopes.

*Metharme* Dr. Eltringham groups with *aoede*, and finds the claspers of these different from all others. This grouping together certainly looks wrong. The geographical distribution of these two is similar, but not identical. The former being more western, occurring at Ega on the Amazon, and stretching to Pebas and Iquitos into Colombia. It is never an abundant species and occurs only sparingly. The locality British Guiana often quoted must, I think, be an error. It is a very constant species, and practically no variation is found. With *aoede* very definite geographical races are found in British Guiana, the lower Amazon, the upper Amazon and Peru. The species is in some localities quite plentiful, as on the lower Amazon, especially about Para, which produces the typical form.

There is nothing beyond the genitalia to even suggest they might be the same. The body is entirely black in *metharme* except for a yellow streak below on the abdomen, while all the subspecies of *aoede* show the pairs of subdorsal yellow spots, and these show no sign of varying. Again, the apical yellow band of *metharme* is in quite a different position to any part of the group of yellow spots of *aoede*.

Then *sappho*, *antiochus*, *leucadia* and *sara* are found to be indistinguishable. *Leucadia* and *sara* might well be the same species, as some forms of *leucadia*, such as *pseudorhea*, are exceedingly like some forms of *sara*. But that *sappho* and *antiochus* could also be the same species seems improbable. *Antiochus* at low levels is exceedingly constant. At higher elevations it is very frequently yellow instead of white-banded, and at certain localities (always above 3000 ft., I believe) it is even constantly yellow-banded as in the form *aranea*. *Sara* is present frequently where *antiochus* is found, but there does not appear to be any cause to think they are the same. *Sara* is smaller, of a different shape, and is always yellow-banded from sea-level up to 3000 or 4000 ft., varying only geographically in the width of the band. *Sappho* has quite a different geographical range, and occurs in its varying geographical races from Guatemala to Colombia and Ecuador, not occurring on the east side of South



America. In shape and size it is also quite different. *Sappho*, like *antiochus* and one or two other Heliconines, occurs with white bands at sea-level and low elevations, while at higher elevation it becomes yellow-banded as in *primularis*. But this change from white to yellow is not universally true in passing from a low elevation to a higher one.

Of *burneyi* and *wallacei* Dr. Eltringham says, "Some of the forms of *burneyi* are rather variable. Those of *wallacei* exhibit a structure intermediate between the extremes of those of *burneyi*." This really amounts to the fact that it is impossible to separate these two by the genitalia. Apart from the quite different fascies these two species have different antennae. The whole of the long club on the underside is orange in the different forms of *burneyi*, but black in all the forms of *wallacei*. The antennae of *burneyi* are also longer, having 40 joints against 37 in *wallacei*. On the evidence that is to hand it is quite impossible to regard these as the same species. They frequently occur together in various localities, but never show any intermediates, and in fact have very little in common except the short red streaks on the underside of the hindwing.

*H. ethra* and *H. robigus* are found to be alike and of a distinctive type. These are quite likely the same. They have a similar brand on the underside of the inner margin of the forewing. *Ethra* is probably the more northern race of *robigus*. It occurs with *narcaea flavomaculata* at Bahia, while *robigus* flies with typical *narcaea* at Rio and southwards. By the additional evidence of the curious brand to that of the genitalia it looks as if it was wrong to in any way connect the two forms with *silvana*, which has no such brand.

In reviewing the classificatory results obtained by Mr. Eltringham from microscopical examination of the genitalia, it appears evident that these organs are not wholly reliable in differentiating species, and that to base a classificatory scheme on this one character alone would give results, which in the light of further evidence as to geographical range, etc., would be untrue. It would be far safer to unite only those species of which we have complete transitional series, when we could take as confirmation a wholly constant genitalia. It is very necessary to be on one's guard, with a group where so comparatively little variation is found in these organs, not to accept

as one species, without further proof, forms with identical genitalia. Among the moths *Zygaena lonicerae* and *Zygaena trifolii* in all its forms have the same genitalia, so also have *Plusia iota* and *Plusia pulchrina*, yet we know these to be distinct species, the two latter having distinct larvae besides well-differentiated imagines. On the other hand, where differences occur we doubtless have evidence of specific distinctness which in some of the Heliconine instances was not even suspected.